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A high precision GC-C-irmMS technique to analyse $\delta^{13}CH_4$ in air entrapped in polar ice cores

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Past atmospheres can be reconstructed by the analysis of polar ice cores which archive ancient air in decadal to centennial resolution. Due to the different carbon isotopic signature of different methane sources high precision measurements of $\delta^{13}CH_4$ in ice cores supply clues about the global methane cycle.

We developed a highly automated (continuous flow) gas chromatography combustion isotope ratio monitoring mass spectrometry technique (GC-C-irmMS) based on the system described by Merritt et al. (1995). The methane is melt-extracted from $\sim$200 g ice using a purge and trap method, separated from the main air constituents, combusted and measured by a conventional isotope ratio monitoring mass spectrometer. A CO_2 standard, a CH_4 reference and an air reference are used to identify potential sources of isotope fractionation within the entire sample preparation process and enhance the stability, reproducibility and accuracy of the system. After correction for gravitational fractionation pre-industrial ice samples from Greenland (1826 AD $\pm$ 40 a) show a $\delta^{13}C$ of -49.29 per mill $\pm$ 0.15 and Antarctic samples (1533 AD $\pm$ 20 a) show a $\delta^{13}C$ of -47.77 per mill $\pm$ 0.41 in good agreement with data presented by Ferretti et al. (2005).